CASE STUDY

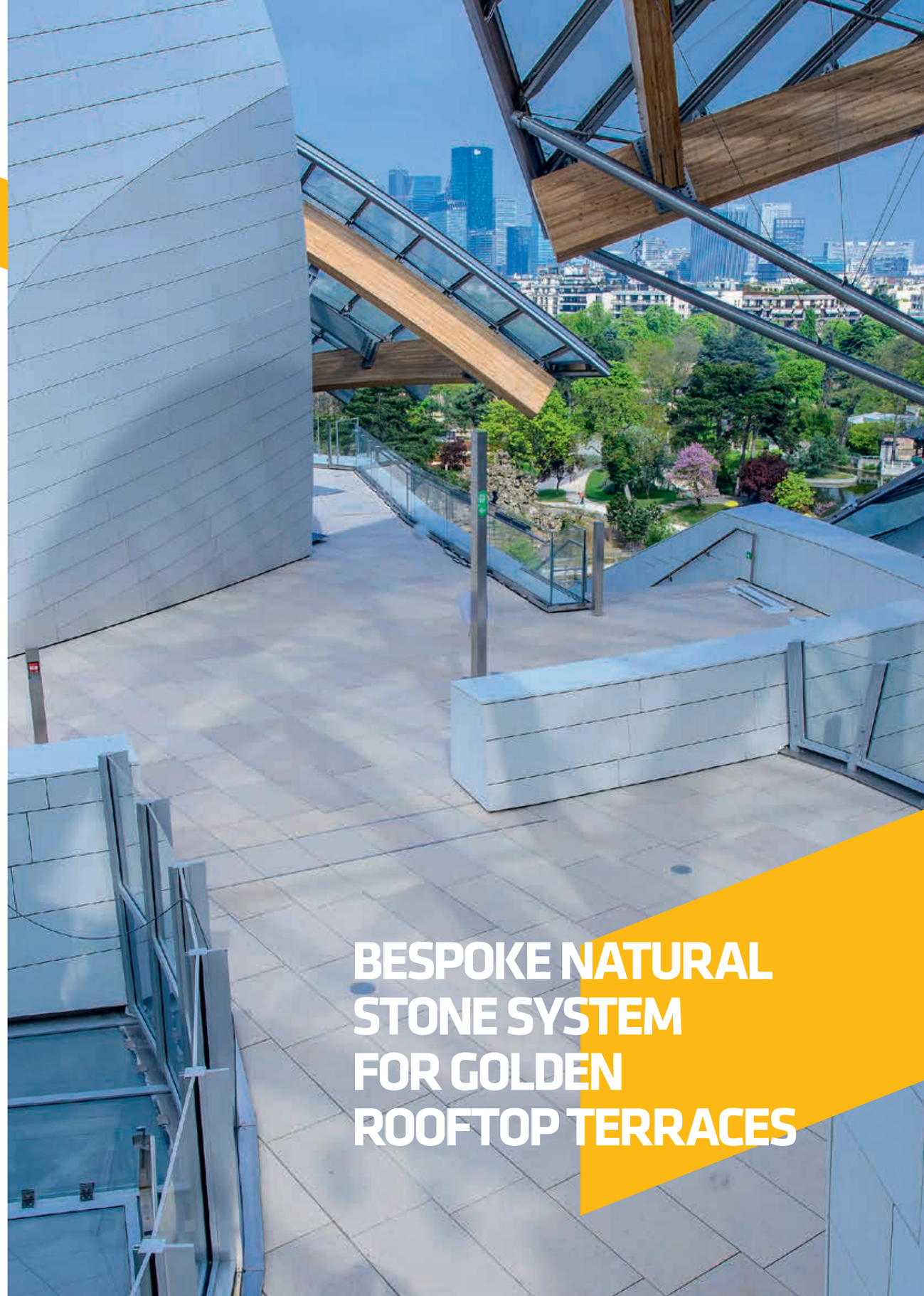
MUSEUM LA FONDATION LOUIS VUITTON, PARIS

ZOONTJENS
A CRH COMPANY

BESPOKE NATURAL STONE ROOF TERRACES

Opened in Paris in October 2014. Bernard Arnault, owner of the Louis Vuitton Moët Hennessy group commissioned this eye catching building, working in collaboration with the Canadian-American architect Frank Gehry. The museum and cultural centre La Fondation Louis Vuitton pour la création has become a reflection of the LVMH group. Like a giant glass cocoon, this modern building, located in the heart of the Jardin d'Aclimation in the Bois de Boulogne in Paris, is a contemporary translation of the traditional glasshouses of the nineteenth century, with a surface area of 11,700 m².

Attention is above all focused on the five rooftop terraces of this remarkable building, which in addition to their aesthetic and accessibility functions are also intended to fulfil a third role. A natural stone rooftop terrace has been designed on the basis of DNS® Heavy raising and levelling system. The building has been compared to an iceberg surrounded by a bank of clouds in glass. Frank Gehry, the architect who was also responsible for the Guggenheim museum in Bilbao, added a further dimension to this building and its spacious rooftop terraces with twelve screens of curved glass. The heart of the building houses exhibition areas and an auditorium. The daring architecture symbolises the ties between the group of companies with modern art, and is an expression of the creativity and innovation held in such esteem by the LVMH group. Since 1991, Bernard Arnault has been viewed as an authority in the art world thanks to his huge donations to various museums. In March 2014, at New York's Museum of Modern Art, he received the David Rockefeller Award, presented only to the most generous of commercial patrons.



WASHING GLASS ROOFS

The glass screens that shield the building are partially cleaned by rainfall, at least on the outside; on the inside however, a range of influences cause them to become dirty, making it necessary to periodically clean the glass frontages. In part this work is carried out by window cleaners using rope access techniques but for a majority of the glass roof coverings, the work is undertaken using an articulated leaver arm which travels across the rooftop terraces. These maintenance vehicles, weighing 6.5 tonnes, run on rubber caterpillar tracks. Once in position, large extendable support arms ensure that even at maximum reach, the access platforms remain stable. Anchoring points have also been installed on each rooftop terrace, designed specially to lock the support legs for these vehicles into position.

SPECIAL DEMANDS ON ROOFTOP TERRACE FINISH

The original choice for the finish of the five rooftop terraces – with a total surface area of more than 1400 m^2 – was a natural stone slab on pedestals that complied with the normal standards and requirements for any construction project. The selected slab also met the aesthetic requirements, but proved unsuitable as a durable protection for the underlying waterproof membrane. In addition, the slab floor had to be strong enough to withstand a load of 20 kN per slab, because of the movements and the static supports of the caterpillar vehicles.

To solve this complex technical puzzle, the international firm of architects, Studios Architecture represented in France by Frank Gehry, joined the engineering staff and Vinci Construction France in their search for a system capable of absorbing such massive static and dynamic forces. Impressed by the custom solutions provided for the Odysseum in Montpellier, Europe's first outdoor shopping centre with multiple rooftop terrace squares, where the Dutch modular DNS® Drenoliet® slab system was used, Studios Architecture came into contact with Zoontjens. Eric Herzog, an architect at the firm, was convinced that Zoontjens could fulfil both the aesthetic requirements and meet the special technical challenges of this project.

DEVELOPMENT OF A TAILOR-MADE SOLUTION

The natural stone alone was not strong enough to support the static and dynamic forces of the cantilevered reach systems, Zoontjens therefore proposed an alternative solution: concrete slabs on heavy DNS® pedestals, with a natural stone top layer glued to the concrete – a technique already available and fully mastered by Zoontjens. The slabs are large in size – measuring 900 mm x 500 mm and with a thickness of between 130 mm and 170 mm, depending on the individual rooftop terrace – and are manufactured to order. The golden Rocherons stone selected by Bernard Arnault to harmonise with the Ductal facades of the 'Iceberg' is sawn to size in the stone quarry in the Côte d'Or region of eastern France. The natural stone panels are then transported to the Netherlands to be glued to the concrete roof slabs at the factory, and to undergo a moisture-repellent treatment.

This solution was specially developed for this prestigious project, and fully remained within the project specifications. Both the aesthetic requirements of the architect and client were fulfilled, as were the technical requirements of the contractor and the consultants. However, one difficulty remained: this solution did not comply with the applicable building standards. Given the complexity of the project, it became necessary to investigate whether the solution was indeed viable.

SOUND RESEARCH REQUIRED TO ENSURE ESSENTIAL SAFETY

From the very start, the project was a major challenge for the Research & Development at Zoontjens. The gluing of the natural stone panels to the concrete slabs was first tested, alongside the load-carrying capacity of the slab supports and the terrace slabs themselves. The R&D department was actively involved in the study undertaken in collaboration with the engineering staff, Bureau Véritas, Vinci Construction France and TNO.

The aim of the investigations and tests was to determine the dimensions of the slab necessary to absorb the forces that would be exercised on them, and to ensure that no shifts occur.

During the test series, not only was the rooftop slab system itself tested by The German engineering company, Dipl.-Ing. E. Möller Ingenieurgesellschaft für Tragwerksplanung mbH, but also the fully-adhered roof covering construction. A series of test scenarios was provided, to identify the perfect dimensions and to determine the tolerance values. At the C.S.T.C. (Construction Technology Science Centre) in Wavre (Belgium), theoretical calculation models were prepared, and laboratory tests were undertaken to check the calculations and to determine the fatigue and breaking resistance. With these test results on hand, it was also possible to identify requirements which the support panels, the support arms and the caterpillar tracks of the maintenance vehicle had to meet, in order to exclude all possible risks. This applies in particular to the roof edges and the upstands where provisions have been made for matching and fitting pieces. All calculations were gathered and checked by the French engineering company T/E/S/S – atelier d'ingénierie in Paris, they prepared the technical file on behalf of our client.

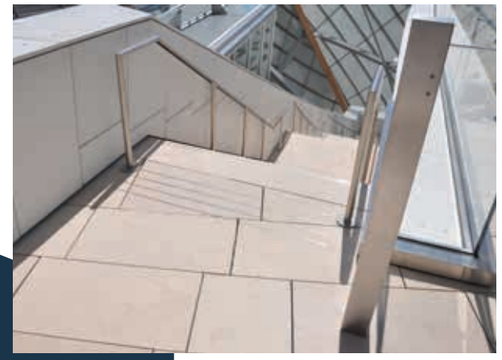
SUPPORT SYSTEM BASIS FOR ROOFTOP TERRACE SOLUTION

The terrace slab floors are laid on the DNS® support system that ensures a perfectly level raised rooftop terrace on a roof covering that itself is set at an angle. This raising and levelling system developed in-house by Zoontjens was used on the museum's rooftop terraces with the DNS® Heavy configuration. This designation means that the heart of the system consists of DNS® Heavy pipes with a diameter of 160 mm sawn to the required height. The wall thickness of the DNS® Heavy pipes has been set at 14.6 mm. The pipes themselves are marked and sawn to size with a laser device, and then installed in a DNS® Heavy pressure distribution foot with a cross-section of 245 mm, using clamping cams.

On top of the DNS® Heavy pipes, a DNS® Heavy support disc is installed, with a cross-section of 245 mm. On the underside, these discs have the same clamping cams as the DNS® Heavy pressure distribution foot. Around the edges, all the pipes are interlinked with stainless steel pipe clamps and threaded ends, to further improve stability.

The roof covering construction for the rooftop terraces is produced from a thermal insulation layer in cellular glass (Foamglas S3) itself fully glued and encased in heated bitumen, with a two-layer fully glued SBS roof covering.

The roof covering structure itself was produced under the responsibility of the main contractor. Beneath the DNS® slab support, the roof covering is double protected, first with a 460 mm x 460 mm disc punched from an SBS roof strip, and on top of that a square plastic distributor panel measuring 450 mm x 450 mm, with a thickness of 40 mm. This distributor panel is fitted asymmetrically, to promote water discharge.
On the slab carriers, a so-called filler disc in EPDM is fitted, complete or in quarter sections, with a cross-section of 245 mm.



DEVELOPMENT AND EXECUTION IN TOTAL HARMONY

Just like all the other teams involved in the construction of the museum, Zoontjens worked in collaboration with all involved parties. The unusual geometry of the rooftop terraces meant that the sizes of the terrace slabs often needed to be subsequently adjusted. Due to their thickness, the majority of slabs were sawn to size in the factory in Tilburg, and subsequently laid in the precise 'earthquake' laying pattern, with its wide open joints. For round and bevelled saw cuts, special equipment was needed, that was only available at the factory.

The development and installation followed a precise sequence. This enabled all the necessary details to be confirmed, the exact number of slabs required, and the stability of the units to be checked and adjusted where necessary.
As a result, the aesthetically-attractive outcome was sufficient to fulfil the expectations of both client and architect.

ADDITIONAL STABILISATION OF THE SUPPORT SYSTEM

To prevent the risk of instability occurring at the edges and upstands, stainless steel edge platforms were installed at the joints, and linked together. The edge platforms were necessary because given the slab pattern and the angle at which the strips of slab were laid, a relatively high number of slab fitting sections had to be used. In these zones, and at points where horizontal forces could occur, the pipes of the support systems have been linked together using stainless steel clamping strips and tie rods.

At one point where two rooftop terraces come together, the expansion inherent in the structure was also continued into the rooftop terrace finish, to ensure that 'shifts and movements' would not result in unintended build-ups in tension, or shifts in the slab pattern.

PROJECT DURATION

The installation of the rooftop terraces on to the membrane took 8 months, between July 2013 and February 2014. In total, some 30 staff worked in shifts, all of them specialists in the use of a vacuum lifting device for laying Pardak® rooftop car park slabs. During the final three months, the teams from Zoontjens worked in double shifts, in order to meet the deadline.

WHAT IF THE WORLD WERE TWICE AS BIG?

It can be, as far as we're concerned. Our world, twice as big. A world that we are helping to design and construct perfectly with our roof slab systems. Our many years of experience have made us the number one expert in rooftop paving. For sustainable roofs, livable roofs for socialising.

We interact with architects and contractors every day. With roofers and project developers: Creators and constructors. We listen to them, work with them and advise them. That's why we're the number one party with the best rooftop vision. It's our higher ground.

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